GRANT & HACKH'S

CHEMICAL DICTIONARY

[American, International, European and British Usage]

Containing the Words Generally Used in Chemistry, and Many of the Terms Used in the Related Sciences of Physics, Medicine, Engineering, Biology, Pharmacy, Astrophysics, Agriculture, Mineralogy, etc.

Based on Recent Scientific Literature

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Completely Revised and Edited by

ROGER GRANT

M.A., D. de l'U., Ph.D., C. Chem., M.R.S.C. *Consultant*

CLAIRE GRANT

M.B., B.S., M.R.C.P.E. *Medical Practitioner*

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nitranilide $C_6H_5N{:}NO{\cdot}OH$ = 138.1. Diazobenzene acid. Phenylisonitramine. Colorless crystals, m.46, soluble in water.
nitrate (1) A salt of nitric acid, or compound containing the radical $-NO_3$. (2) Nitration. **n. acidium*** See *nitracidium ion.* **n. ion** The NO_3^- ion, colorless, and forming no insoluble precipitates with metallic ions. **n. of lime** Calcium n. **n. of potash** Potassium n. **n. of soda** Sodium n. **n. of soda-potash** A crude Chilean saltpeter: sodium nitrate 75, potassium nitrate 25%; a fertilizer.
nitrated Describing an organic compound containing the $-NO_2$ group.
nitratine A mineral form of sodium nitrate.
nitration The introduction of the NO_2 group into an organic compound, usually by means of a mixture of sulfuric and nitric acids.
nitrato-* Prefix indicating the ligand $-NO_3$. Cf. *nitrito-.*
nitrator A vessel, usually double-jacketed, with heating or cooling coils and stirring device, used for nitration.
nitrazepam $C_{15}H_{11}O_3N_3$ = 281.3. Mogadon. Yellow crystals, m.228, insoluble in water. A hypnotic drug of the benzodiazepine group (EP, BP).
Nitrazine **N. Paper** Trademark for a filter paper, impregnated with sodium dinitrophenyl azonaphthol disulfonate; used to indicate pH values: yellow 4.5, olive green 6.2, blue 7.0. **N. yellow** An indicator dye; pH 6.5: yellow (acid) to blue-green (alkaline).
nitre Niter. See *oxygen.*
nitrene The $-NH$ group; analog of carbene.
nitriacidium ion Nitracidium ion.
nitric acid HNO_3 = 63. Colorless liquid, d_0 1.53, m.−40.3, b.86, soluble in water; used extensively as its aqueous solutions: (1) Fuming: 86% HNO_3 with some N_2O_4. Brown-red fuming liquid, d.1.48–1.5; an energetic oxidizing agent in chemical analysis and synthesis. (2) 70% HNO_3. NF, BP strength. (3) Concentrated: 65% HNO_3. Aqua fortis, azotic acid. Faintly yellow liquid, d.1.40–1.42. Used as a solvent for metals and an oxidizing agent; in etching and many chemical operations; and in nitrating organic compounds. (4) 32–34% HNO_3. d.1.20. (5) Dilute: 10% HNO_3. Colorless liquid, d.1.06; a reagent, solvent, and acidifying agent. **chloro ~** See *chloronitric acid.* **peroxo ~*** HNO_4. An acid of doubtful existence.
n. a. anhydride Nitrogen pentaoxide*. **n. a. hydrate** HNO_3 + 32% H_2O. $d_{15.5}$ 1.414, b.121.
nitric ether Ethyl nitrate.
nitric oxide Nitrogen oxide*.
nitridation (1) Formation of metallic nitrides by heating metals in nitrogen to increase hardness. Cf. *nitration.* (2) De-electronation in the ammonia system, analogous to oxidation in the water system. Cf. *nitridizing agent.*
nitride A binary compound of nitrogen and a metal. The alkali and alkaline-earth nitrides are readily hydrolyzed: $Mg_3N_2 + 6H_2O = 3Mg(OH)_2 + 2NH_3$.
nitridizing agent A substance that furnishes nitrogen or causes an exchange of electrons in liquid ammonia; as, hydrogenazide, HN_3; analogous to nitric acid, HNO_3, as oxidizing agent.
nitrifiable Describing a nitrogen compound that can be transformed into nitrates by soil bacteria.
nitrification Oxidation of the nitrogen in ammonia to nitrous and nitric acid or salts.
nitrifiers Soil bacteria which oxidize ammonia and its derivatives to nitrites (as nitromonas) or to nitrates (as nitrobacter).
nitrifying To cause the oxidation of ammonia or atmosphere nitrogen to nitrites and nitrates, e.g., by n. bacteria and n. catalysts.
nitrilase* A hydrolase enzyme that converts a nitrile to a carboxylate and ammonia.
nitrile* See *nitriles.* **iso ~** Isocyanide*.
n. oxides* Compounds of formula $RC{:}NO$. **n. rubber** See *elastomer.*
nitriles* Nitrile is the term in substitutive *nomenclature,* q.v., and cyanide the term in radicofunctional nomenclature for the $-CN$ radical; as, hexanenitrile and pentyl cyanide, respectively, for $C_5H_{11}CN$. **carbo ~** See *carbonitrile.* **di ~*** Dicyanides*. Compounds containing 2 $-CN$ radicals; as, hexanedinitrile, $NC(CH_2)_4CN$.
nitrilo- Prefix indicating: (1)* The bridge $-N=$. (2)* A nitrogen atom attached to 3 identical radicals. Cf. *nitrile.*
Nitrilon Trademark for a polyacrylonitrile synthetic fiber.
nitrine N_3 = 42.02. A hypothetical allotropic form of nitrogen analogous to ozone, O_3. See *active nitrogen* under *nitrogen.*
nitrite* A salt of nitrous acid, or a compound containing the group NO_2^-. The inorganic nitrites of the type MNO_2 are all insoluble, except the alkali nitrites. The organic nitrites may be isomeric, but not identical with the corresponding nitro compounds.
nitrito-* The $-NO_2$ group as a ligand, either as nitrito-*N,* $-NO_2$; or as nitrito-*O,* $-O{\cdot}N{:}O$.
nitro- (1)* A prefix denoting the radical $-NO_2$. Nitroxyl is sometimes used when the element is strongly electronegative or is a metal. Nitro compounds are usually yellowish in color, and differ from the less stable, isomeric nitrosooxy compounds. Cf. *nitroxyl, nitrite, nitrito.* (2) A misnomer for nitrate; as, nitroglycerin (trinitroglycerol). ***aci-* ~*** Isonitro-. The radical $HO(O)N=$. **iso ~** See *aci-.*
nitroacetanilide $C_8H_9O_3N_2$ = 181.2. Nitracetanilide. Colorless crystals **1,2- ~** m.92. **1,3- ~** m.151. **1,4- ~** m.210.
nitroacid A compound containing both the radicals $-COOH$ and $-NO_2$; as, $NO_2{\cdot}CH_2{\cdot}COOH$, nitroacetic acid.
nitroalizarin $C_{14}H_5O_2(OH)_2NO_2$ = 285.2. **1,2,3- ~** Alizarin orange. 1,2-Dihydroxy-3-nitroanthroquinone*. Orange-yellow crystals, decomp. 244, slightly soluble in water, soluble in alcohol; used as dye, and as an intermediate in organic synthesis. **1,2,4- ~** Yellow crystals, decomp. 290.
nitroamine An organic compound containing the radical $-NH{\cdot}NO_2$ or $=N{\cdot}NO_2$. **diethyl ~** $Et_2N{\cdot}NO_2$ = 118.1. Colorless liquid, b.206. **dimethyl ~** $Me_2N{\cdot}NO_2$ = 90.1. Colorless crystals, m.58, soluble in water. **ethyl ~** $EtNH{\cdot}NO_2$ = 90.1. Colorless liquid, m.3. **iso ~** A compound containing the radical $-N-O-N{\cdot}OH$. **methylphenyl ~** $MeNPh{\cdot}NO_2$ = 152.2. Colorless crystals, m.39, soluble in water. **phenyl ~** $PhNH{\cdot}NO_2$ = 138.1. Colorless crystals, m.46, soluble in water. **propyl ~** $PrNH{\cdot}NO_2$. Colorless liquid, b.140.
nitroamino The radical NO_2NH-. **n.acetic acid** $C_2H_4O_4N_2$ = 120.1. A homolog of nitrourethane. Colorless crystals, m.103, soluble in water (strongly acid).
nitroaniline $NH_2{\cdot}C_6H_4{\cdot}NO_2$ = 138.1. **1,2- ~** Colorless needles, m.71, soluble in water. **1,3- ~** Yellow needles, m.114, slightly soluble in water. **1,4- ~** Yellow needles, m.146, soluble in water. All used in organic synthesis and as indicators for strong acids. **di ~** See *dinitroaniline* under *aniline.*
nitroanilines Compounds derived from benzene by the substitution of 2 or more H atoms by one or more NH_2- and NO_2- radicals. The higher-nitrated anilines are powerful explosives.
nitroanisole $C_6H_4(OMe)NO_2$ = 153.1. ***ortho-* ~** 1-Methoxy-2-nitrobenzene*. Yellow liquid, d.1.268, m.9, b.265.

tri ~* $H_6Si_3O_{10}$ = 250.3. White, insoluble powder. **tetrahydrogen decawolframo ~*** $SiO_2 \cdot 10WO_3 \cdot 2H_2O$ = 2415. Silico(deci)tungstic acid. White powder; a reagent for cesium (insoluble salts).

silicide Compounds of the type M_xSi_y, as, Mg_2Si, $CaSi_2$, Fe_3Si.

silicification The gradual replacement of rocks or fossils by silica. Cf. *petrifaction.*

silicified Describing an organic material, e.g., wood, that has been petrified.

silicium Silicon.

silico- Prefix indicating silicon, generally in organic compounds. **s.benzoic acid** PhSiOOH = 138.2, m.92, insoluble in water. **s.bromoform** $SiHBr_3$ = 268.8. Heavy, colorless liquid, d.2.7, b.116, decomp. by water. **s.butane** See *silanes.* **s.calcium** A product of the electric furnace used to deoxidize steel. **s.chloroform** $SiHCl_3$ = 135.5. Colorless liquid, d.1.34, b.34, decomp. by water. **s.decitungstic acid** Tetrahydrogen decawolframo*silicic acid.* **s.ethane** See *silanes.* **s.fluoride** Hexafluorosilicate*. **s.fluoric acid** Hexafluorosilic acid*. **s.heptane** Triethyl silane*. **s.hydrides** Silanes*. **s.iodoform** $SiHI_3$ = 409.8. Heavy, colorless liquid, d.3.4, b.220, decomp. by water. **s.methane** Silane*. **s.oxalic acid** HOOSi·SiOOH = 122.2. White, unstable solid.

silicol R_3SiOH. Hydroxysilane. **triethyl ~** Et_3SiOH = 132.3. Silicoheptyl alcohol. Colorless liquid, b.154, insoluble in water.

silicon* Si = 28.0855. Silicium. A nonmetallic element of the carbon group, at. no. 14. Allotropic modifications: (1) *Amorphous:* Brown powder, d.2.35. (2) *Crystalline:* Gray crystals, m.1412, b. ca. 2480, insoluble in water. (3) *Graphitoidal:* Dense crystals, or graphitelike masses deposited from molten s. (4) *Adamantine:* Hard needles. Principal valency 4. S. forms many complex compounds on the earth surface (rocks). Used in alloys to impart hardness, and in semiconductors. See *silica minerals.* **ethyl ~** The radical ≡SiEt. Cr. *silanes.* **methyl ~** The radical ≡SiMe. **radio ~** A s. isotope, mass 27. Cf. *radioelements.*

s. alkyls (1) Hydrogen compounds of s. corresponding with hydrocarbons; as, SiH_4, silane. (2) Organic compounds of s. and alkyl radicals; as, Me_4Si. See *silanes.* **s. alloys** Noncorrodible alloys of s. with metals; as, Duriron. Cf. *silicon copper.* **s. borides** SiB_3, SiB_4, and SiB_6 exist. Black, irregular crystals, of high m.; very hard, and good conductors of electricity. **s. bromides** (1) $SiBr_4$ = 347.7. S. tetrabromide*. Colorless, fuming liquid, b.154, decomp. by water to silicic acid. (2) Si_2Br_6 = 535.6. S. tribromide*. Colorless solid, b.240, decomp. by water. **s. bronze** A noncorrodible alloy: Cu, Sn, with 1–4% Si. **s. carbide*** SiC = 40.10. Colorless plates, dissociates 2250; used in refractories and abrasives. **s. chip** A wafer of pure s. printed with alternate insulating and semiconducting layers, on which the pattern of an electric circuit is etched. Wafers fused together can contain thousands of circuits. **s. chlorides** (1) $SiCl_4$ = 169.9. S. tetrachloride*. Colorless, fuming liquid, d.1.524, b.58, decomp. by water to silicic acid. Used in electrotechnics, and mixed with ammonia vapors, in smoke screens. (2) Si_2Cl_6 = 268.9. S. trichloride, b.146, decomp. by water. (3) Si_3Cl_8 = 367.9. S. octachloride*. White powder. **s. controlled rectifier** SCR. Thyristor. A fast-acting switching device made from 4 alternate layers of n- and p-type silicon. **s. copper** An alloy: Si 20–30, Cu 70–80%, used in metallurgy. **s. dioxide*** Silica. **colloidal ~** Used in pharmacy as a suspending agent and stabilizer (NF). **s. disulfide*** SiS_2 = 92.2. White needles, sublime when heated, decomp. by water. **s. ethane** See *silanes.* **s. ethyl** Tetraethyl*silane**. **s. fluorides** (1) SiF_4 = 104.1. S. Tetrafluoride*. Colorless, suffocating gas, b_{1810mm} −65, decomp. by water to hexafluorosilicic acid, soluble in alcohol. (2) Si_2F_6 = 170.2. S. subfluoride. White powder. **s. hydrides** Silanes*. **s. iodides** (1) SiI_4 = 535.7. S. tetraiodide*. Colorless solid, m.121, insoluble in water. (2) Si_2I_6 = 817.6. S. subiodide. Colorless solid, m.250 (in vacuo), decomp. by water. **s. iron** Ferrosilicon. Iron contianing 2–15% Si; used in metallurgy. **s. magnesium** See *magnesium silicides.* **s. methane** Silane*. **s. methyl** Tetramethyl*silane**. **s. nitride** Si_3N_4 = 140.3. White powder insoluble in water, existing in 2 hexagonal phases stable below and above 1400–1450°C, respectively. Very resistant to thermal shock and chemical reagents; used as a support for catalysts and in stator blades of high-temperature gas turbines. **s. octachloride*** See *silicon chlorides.* **s. oxide** Silica. **s. oxychlorides** Si_2OCl_6, b.137; $Si_4O_4Cl_8$, b.200; $Si_4O_3Cl_{10}$, b.153; also $(SiOCl_2)_n \cdot O(SiCl_3)_2$, where n = 1 to 4. **s. steel** Steel containing 2–3% Si; hard and brittle. **s. sulfide** S. disulfide*. **s. tetrabromide*** See *silicon bromides.* **s. tetrachloride*** See *silicon chlorides.* **s. tetrafluoride*** See *silicon fluorides.* **s. tetraiodide*** See *silicon iodides.* **s. tetraphenyl** Tetraphenyl*silane**. **s. tungstic acid** Silicotungstic acid. **s. zirconium** An alloy used to purify molten steel.

silicone (1) Contraction of silicoketone. A polymer containing $-Si(R_2)O-$ groups. Lower molecular weight compounds are oils (used as lubricants and in polishes); higher are inert solids with good electrical insulation properties. (2) $H_3Si_3O_2$ = 119.3. Yellow solid. **s. alloy** A compound produced by the simultaneous polymerization of 2 silicones; e.g., tetravinyl s. and methyl hydrogen siloxane give a s. alloy of high water repellency. **s. release paper** Protective backing paper that is easily removed when required, as on self-adhesive labels. **s. rubber** A s. that retains its elastic properties between −50 and +291, and can be kneaded; used for protective coatings on wires and for high-temperature lubricants.

siliconic acid R·SiOOH, analogous to organic acids. Cf. *carbylic acid.*

silicono The radical (HO)OSi−, derived from metasilicic acid.

Silicool Trademark for a protein synthetic fiber.

silicosis A form of pneumoconiosis due to silica dust less than 10 μm in diameter. U.K. limit is 0.1 mg/m^3 of respirable air.

silicotungstate A salt of silicotungstic acid, especially with the alkaloids.

silicotungstic acid $H_4[SiW_{12}O_{40}]$ = 2878. Tetrahydrogen dodecawolframosilicate*. Dodecawolframosilicic acid*. Yellow crystals, soluble in water; used in alkaloid analysis.

silicyl The silyl* radical. **di ~** The disilanyl* radical. **s. oxide** $(R_3Si)_2O$; as **hexaethyl ~** $(Et_3Si)_2O$ = 246.5. Colorless liquid, b.231.

silicylene The silanediyl* radical.

silk (1) Fibroin, sericin. The fibrous envelope of the silkworm before the chrysalis state (cocoon). It consists of fibroin (the fiber protein) and sericin (the gummy protein). (2) A sieve for grading flour: no. 5 = 0.270, no. 8 = 0.190 mm aperture. (3) A series of parallel fine-line inclusions in certain gems (e.g., rubies). Cf. *asterism.* **"all-~"** S. containing fillers, but no other fibers. **artificial ~** Rayon. **net ~** S. fabric made from yarns of continuous s. filament. **pure ~** S. fibers without fillers. **schappe ~, spun ~** Describing a fabric made from silk-waste staple fiber. **vegetable ~** (1) The floss from the seeds of *Calotropis gigantea* (Asclepiadaceae), Asia. (2) Kapok.

Subentries are shown in boldface type. If the main entry word is to be repeated in front of the subentry word, it is shown by its initial letter as follows and spaced appropriately:

dibenzyl . . . d.amine	Read as *dibenzylamine*
acetoacetic . . . a. acid	Read as *acetoacetic acid*

If the main entry is to be repeated after the subentry word, it is shown by the symbol ~ and spaced appropriately as follows:

agent . . . balancing ~	Read as *balancing agent*
acetone . . . acetonyl ~	Read as *acetonylacetone*
acridine . . . diamino ~ chloride	Read as *diaminoacridine chloride*

Sub-subentries, shown in smaller boldface type, refer to the immediately preceding bold subentry.

acetamido . . . a.naphthol . . . 1,2- ~	Read as *1,2-acetamidonaphthol*

Trade names and registered trademarks have a capital initial letter. The listing of a word as a free chemical term does not necessarily mean that it has not been adopted as a trade name or trademark. However, there is no intention to use a term in a generic sense if it is in fact a trade name or trademark. Where the legal status of a trade name or trademark is important, the reader should check the current status. British and other non-American trademarks for drugs are listed under the USP or NF name, but the products may not meet the USP or NF specification.

Where an entry is both a trademark or trade name and a generic name, the entry generally has a capitalized initial and is followed by the trademark or trade name definition first; then, after "(Not cap.)," by the generic definition.

Letters in parentheses in or at the end of a word defined indicate an alternative method of spelling. Thus, "flavin(e)."

Water of crystallization is shown with a center dot: e.g., $Na_2SO_4 \cdot 10H_2O$.

The usual order of presenting or describing a compound is: Name. Formula = molecular weight. Synonyms. Occurrence, preparation, or type of substance. Color; state (e.g., liquid) at room temperature; density (of more important compounds); melting point or boiling point (in °C); solubility (in water unless otherwise specified; mention of solvents other than water implies low solubility in water); chemical, industrial, and medicinal uses.

Temperatures are all in °C unless otherwise stated.

Symbols are defined in the appropriate places (see especially the initial entries under each letter of the alphabet) and under the entries *constant, nomenclature, SI,* and *symbol.*

Abbreviations Commonly Used in This Book

Å	angstrom unit.
α	specific rotation (e.g., $[\alpha]_D^{20}$ is the value of α for the D line at 20°C).
abbrev.	abbreviation.
Ac	acetyl, CH_3CO- (e.g., AcOH is acetic acid).
Ar	aromatic.
at.	atomic (e.g., at. wt., at. no.)
b.	boiling point in °C (e.g., $b_{600mm}60$ means boils at 60°C under a pressure of 600 mm of mercury).
BP	British Pharmacopoeia.
Bu	butyl, C_4H_9- (e.g., BuOH is butyl alcohol).
Bz	benzoyl, PhCO− (e.g., BzOH is benzoic acid).
ca.	approximately (circa).
Cf.	compare.
CGPM	General Conference on Weights and Measures (Conférence Générale des Poids et Mesures).
C.I.	Color Index.
cryst.	crystalline or crystallizing.
d.	density at room temperature. d_{0° for density at 0°C. $d_{25/4}$ for density at 25°C relative to water at 4°C (= 1.000). $d_{air=1}$ for density compared with air.
decomp.	decompose, -osing, -oses, or -osed (e.g., decomp.20 means decomposes at 20°C).
EP	European Pharmacopoeia (correctly: Eur.P.).
Et	ethyl, C_2H_5- (e.g., EtOH is ethyl alcohol).
insol.	insoluble in water.
ISO	International Organization for Standardization.
IUB	International Union of Biochemistry.
IUPAC	International Union of Pure and Applied Chemistry.
IUPAP	International Union of Pure and Applied Physics.
M	a monovalent metal.
M	molar, molarity.
m.	melting point in °C (used similarly to b., boiling point).
Me	methyl, CH_3- (e.g., MeOH is methyl alcohol).
N	normal, normality.

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Edited by
Robert Doering
Yoshio Nishi

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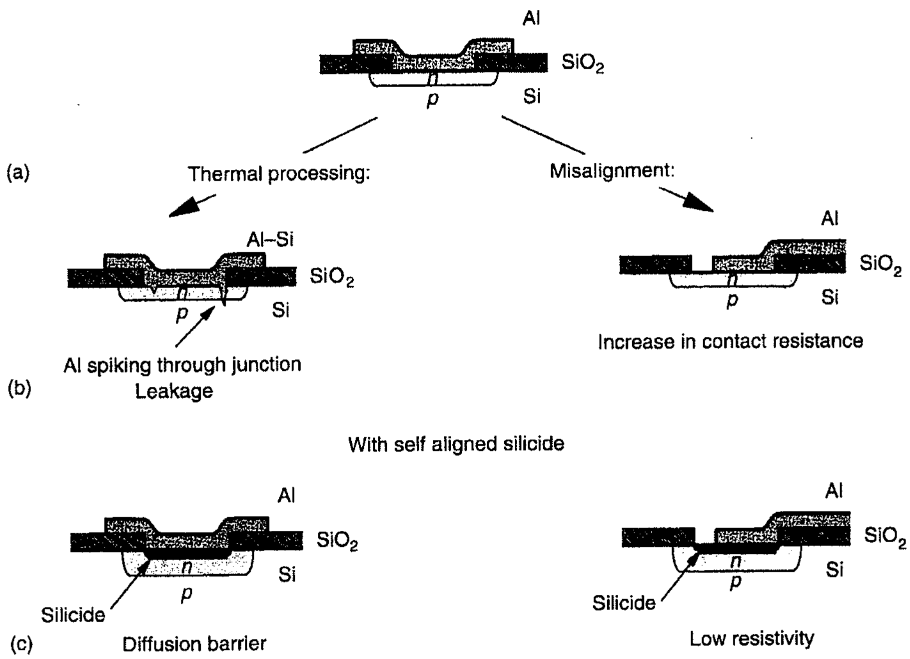

FIGURE 10.1 Schematics describing early metallization. (Adapted from d'Heurle, F. M. *J. Electron. Mater.* 27, 1138, 1998.)

to the alignment of masks defining the contact. First, the post contact anneals were found to lead to Al spiking in the Si, possibly shorting the electrical junction below the contact (Figure 10.1b). The formation of these spikes was caused by the dissolution of Si into the Al. As the temperature increases, the solid solubility of Si in Al increases to more than 1 at% at 500°C and close to 2 at% at the eutectic temperature of 577°C [13]. The first solution to avoid dissolution of Si in Al was to deposit an Al–Si alloy already containing Si above the solubility limit. While fixing the dissolution problem, this also led to a slight increase in the resistivity of the material. More importantly, since the solid solubility of Al in Si decreases with decreasing temperature, upon cooling the devices, some Si precipitates epitaxially at the Si–Al interface. This Si is p-doped as it is saturated in Al and thus gives rise to an increased contact resistance especially on *n*-type Si substrate. As the size of the contacts reach the size of the epitaxial islands, this process simply becomes unusable. The electrical characteristics of the device were also very dependent on the alignment of the contacts. As also shown in Figure 10.1b, any misalignment of the Al did lead to a reduction in contact area, a critical factor for the injection of the carriers in the device.

Figure 10.1c shows how the addition of a silicide layer directly formed on the source, drain and gate of transistors before metallization and patterning can help to solve both problems above. Indeed, the silicide limits the diffusion of Si and also renders the contact relatively insensitive to misalignments of the Al because of the low resistivity of the selected silicide. As long as the Al contact touches the silicided area, the carriers distribute quickly through the silicide and uniformize the carrier transport even if the contact is not perfectly aligned.

10.2.2 The Self-Aligned Silicide (Salicide) Process

The formation of the silicide over the exposed Si areas of an integrated circuit is performed using a self-aligned process schematically presented in Figure 10.2. The term self-aligned refers in this case to

a process for which resist and lithography steps are not necessary [8–12]. This method dramatically reduces the complexity and cost of forming the first contact to the Si areas. The process flow is described for a standard MOSFET build on a Si on insulator substrate. In Figure 10.2a, after critical surface cleaning steps, the wafer is coated with a thin metal layer often directly followed by the deposition of a capping layer to prevent oxidation during subsequent anneals. While the first industrial process using Ti did not require the use of a capping layer, the particular sensitivity of Co silicide formation to the presence of oxygen required the presence of a capping layer. The most recent Ni silicide formation has been successful in many circumstances without capping layers but its sensitivity to oxide and oxidation, although not as high as for Co silicide formation, is important so cap layers may be advantageous depending on environment and process conditions.

Figure 10.2b shows the transistor after a first anneal to form silicide over the exposed Si areas. The temperature of this anneal cannot be so high as to allow Si diffusion in the metal leading to a silicided connection shorting the source and gate of transistors, a phenomenon referred to as bridging. The annealing process must be carefully selected to form a silicide phase that resists the etch solutions capable of removing metal layers. After this anneal, the metal is then selectively etched typically in solutions of hydrogen peroxide (H_2O_2) and sulfuric acid (H_2SO_4). Once the metal is removed (Figure 10.2c) and with it the possibility of bridging, a second anneal can be performed to obtain a more suitable silicide phase if necessary. This is certainly the case for Ti and Co silicides. For Ni silicide, however, it is feasible to use a single step anneal but many have argued that a formation with two anneals is still desirable [14–18]. Nowadays, after completing the silicide formation, the device wafer is capped with interlayer dielectrics and vias are then opened to make connections to the silicide (10.2d). While these process steps are not specifically related to silicide formation and will be covered in a different chapter of this book, they are mentioned here to emphasize the importance of the silicide as an etch step for the opening of the via

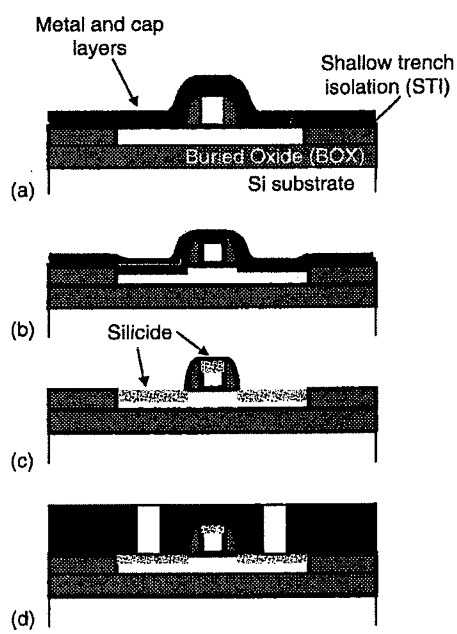

FIGURE 10.2 Schematics describing the self-aligned silicide process.